Human Factors & Medicine Panel 252 NATO Research Task Group on Aircrew Neck Pain

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Disclosure

- The views expressed in this presentation are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, nor the U.S. Government
- I have no financial relationships to disclose
- The research discussed in this presentation is not my own
- Slides are not for wide distribution

Outline

- Background
- Epidemiology Studies
- NATO RTG Participants
- Programme of Work
- Current and Future Work

Background

- Growing evidence that neck pain is a significant problem in aircrew
- Causal relationship established between neck injury and military aviation duties
- EMRs can be used to establish clinically relevant incidence rates
- Most Armed Forces are evaluating the problem and developing mitigation strategies
- NATO Research Task Group on Aircrew Neck Pain Jun 2014

Epidemiology - USA

- Established causal relationship between neck injury and military aviation duties
  - 60 % rate reported in 1987 in Navy and Marine Corps aviators (1)
  - From 1980 to 1990 Yacavone et al. reported the “most common G-associated injury pattern was simple cervical muscle strain” (2)
  - In 1993 Hämäläinen et al. reported radiologically significant disc degeneration on MRI in pilots exposed to high +Gz loading compared to non-exposed pilots. Most previous studies have relied on surveys (3)
  - Study published in October of 2014 reported no difference in aviator neck pain across platforms [Tactical fixed-wing (TFW), other fixed-wing (OTW) rotary-wing (RW)] (4)
    - Meta-analysis based on previous cross-sectional studies (surveys)
    - Subject to significant bias
- The Defense Medical Surveillance System (DMSS) can be used to establish clinically relevant incidence rates
  - DMSS contains over 14 million person years of health surveillance data (5)
  - Ongoing work to review DMSS data - 28 ICD-9 codes relevant to neck pain from 2008-2013
  - Represents neck pain significant to require Flight surgeon, therefore true incidence rates
  - Misses neck pain not reported to Flight Surgeon
    - Negative ramifications for reporting neck pain
    - Taken off flight status

Epidemiology – RCAF

- Neck and low back pain in RW Aircrew has been a concern for more than a decade
- Previous studies linked neck trouble with the use of NVG, mission length, stature, and vibration among other factors
- A survey was distributed online to RCAF CH-146 Griffon helicopter Pilots and Flight Engineers
- Preliminary results show statistically significant links between NVG hours and neck pain; and total military flying hours with low back pain
- The survey identified potential mitigation targets such as better helmet fit procedures
- Survey results have also enabled the development of mitigation strategies to reduce neck and low

Trouble location	**Top 3 factors blamed by pilots** (number of participants)	**Mean causal rating**	**Top 3 factors blamed by FE** (number of participants)	**Mean causal rating**
Neck	Wearing NVG (76)	69	Wearing NVG (44)	69
	Long mission (59)	67	Long mission (37)	72
	Wearing night HUD (58)	60	Frequent flying (35)	68
Lower back	Long mission (35)	67	Long mission (9)	67
	Vibration (27)	68	Night flight (8)	57
	Night flight (26)	57	Frequent flying (7)	64

Epidemiology – RCAF - *DRAFT*

- An analysis of CFHIS database was conducted in Jul 2014 looking at neck and back pain of RCAF Pilots, FE and LMs with a specific focus on RCAF Squadrons and flight roles
- Regular Force personnel at 33 select RCAF squadrons, Males & Females, Ages 18-60, July 2013-June 2014
- 730 ICD-10 codes for MSK-related conditions were included
- Common Lumbar conditions had the highest rate of incident (new) diagnoses (111.8 per 1,000py), followed by Common Cervical (50.7), Lumbar Radiculopathy (12.9) and Cervical Radiculopathy (6.9)
- The IDR for each of these 4 neck & back conditions was highest in FEs
- FE have an unadjusted IDR of 84.2 per 1,000 person-years, compared to 46.1 for Pilots and 15.2 for LM
- Increased risk of Common Cervical diagnoses were observed among TRW / CS FE (141.2) and TFW Pilots (131.4)
- RCAF TFW pilots have the highest (unadjusted) incidence of diagnoses for common cervical conditions
- TFW cervical IDR were more than 4 times the rate for Transport and Mixed RW/FW roles
- The unadjusted IDR of new cervical radiculopathy diagnoses is considerably higher among FE (20.0) compared to Pilots (1.3)

HFM 252 NATO RTG Participants

- Canada
- USN
- USA
- UK
- France
- Germany
- Italy
- Netherlands
- Portugal
- Norway
- Denmark

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Programme of Work

- Problem Definition
  - Literature Reviews
  - Survey Recommendations
- Mechanisms and Factors
- Tools and Techniques
- Research Metrics
- Preventative/Mitigation Solutions
  - Engineering Based Solutions
  - Intervention Program
- Treatments

Problem Definition

- Literature Review
  - Epidemiology Studies
  - Vibration and G effects
  - Equipment and HSM effects
  - EMG placement, Modelling
  - Current Interventions
- Surveys
  - Compile and compare past work
  - Create a validated survey model for future use

Mechanisms & Factors

- Head Supported Mass & Pain
- Human Systems Integration Issues
  - Mission/Task Analysis
  - Work Rest Cycles
- Poor Ergonomics
  - Helmet Fit
  - Cockpit/Instrument Alignment
- Poor fitness, balance, stability
- Education

Tools & Techniques

- **Neck/Spine Models**
  - **NAVAIR Pain and Injury Prediction Model**
  - **USAARL Vibration/HSM Injury Model**
- **Task & Physical Demands Analysis**
  - **RCAF CH-146 Griffon**
  - **UK CH-47 Chinook**

RCAF CH-146 Aircrew Analysis

- Mission
- Function Task Analysis
- Physical Demands Analysis

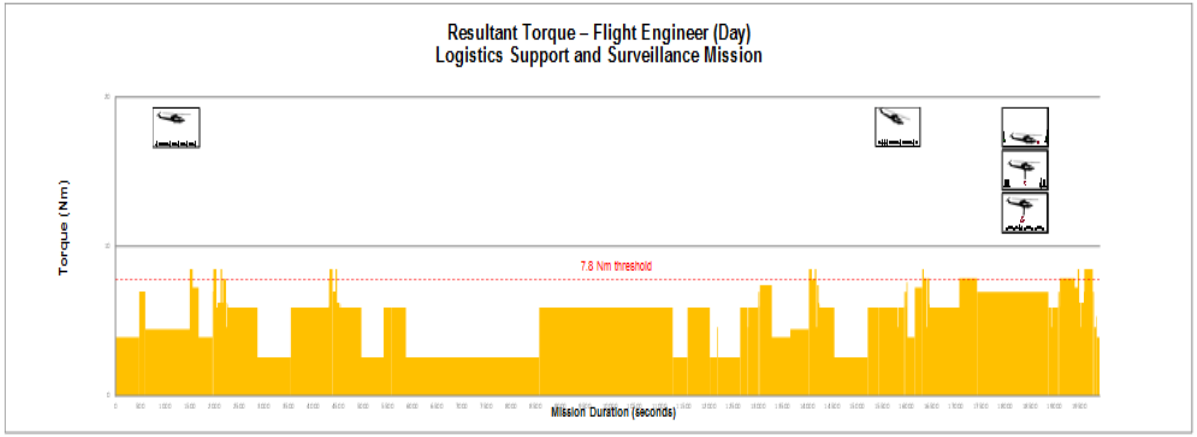


Figure 23: Resultant Torque – Flight Engineer (Day) Logistics Support and Surveillance Mission

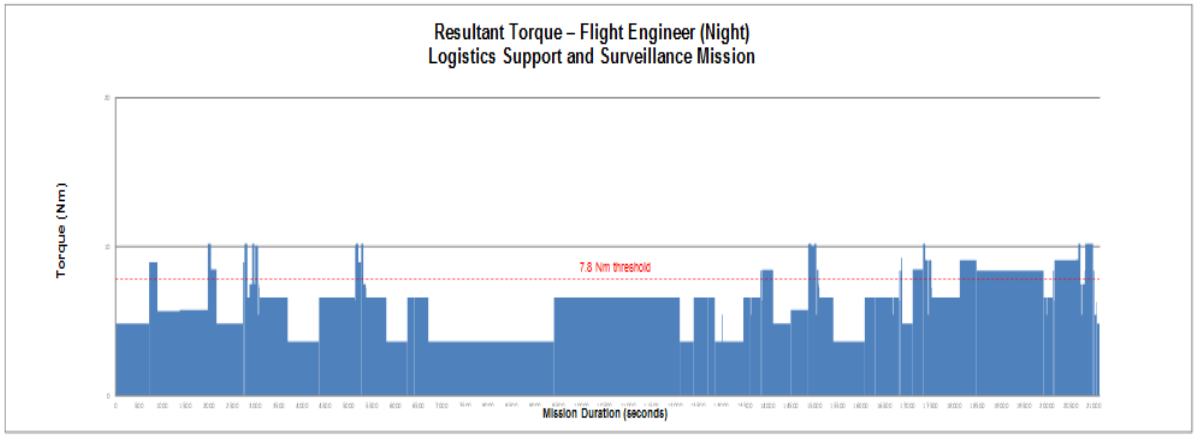


Figure 24: Resultant Torque – Flight Engineer (Night) Logistics Support and Surveillance Mission

Research Mechanisms

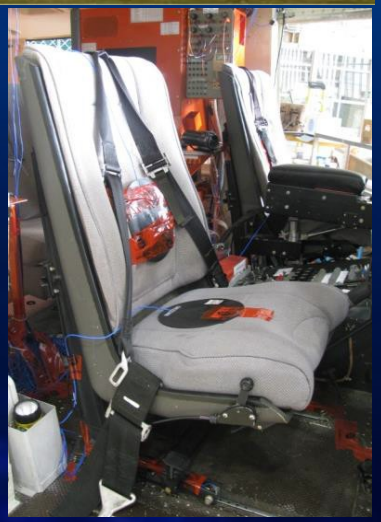
- Pain Definitions
  - Scales
  - Operational Definition
  - Operational Impact
- EMG Standards
  - Lead placement/depth/#
- Experimental Measures
  - Physiological
  - Subjective

Engineering Based Solutions

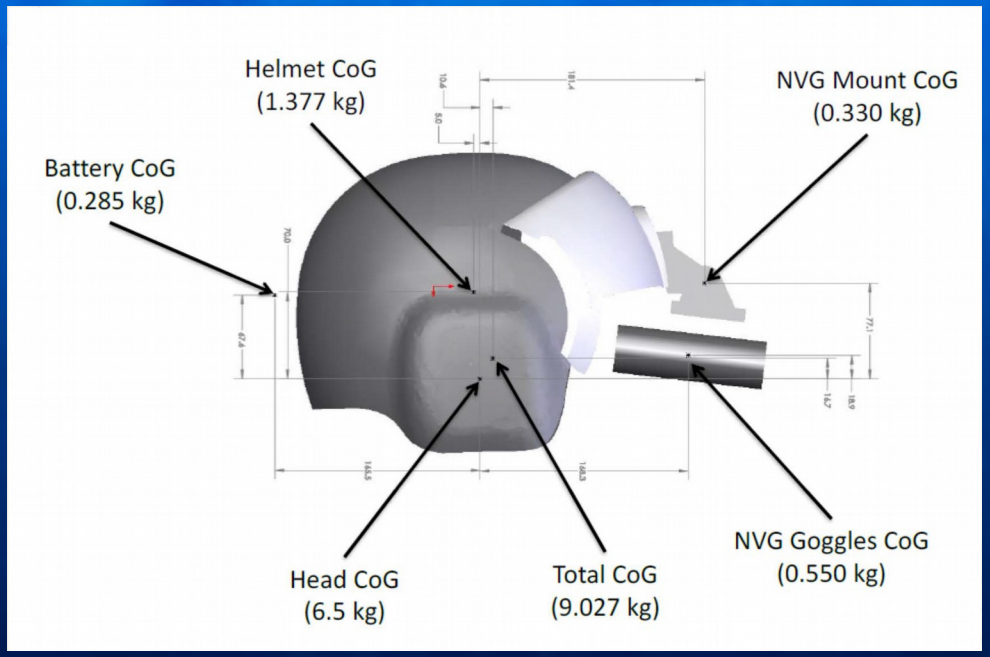
- Crew Station Ergonomics Information
  - Seat Vibration Mitigation
  - Seat Ergonomics
- Head Supported Systems Mechanical Properties Requirements
  - How much can the human body support?
  - Generate a STANAG for future helmets
- Head and Neck Support Devices

Vibration Mitigation

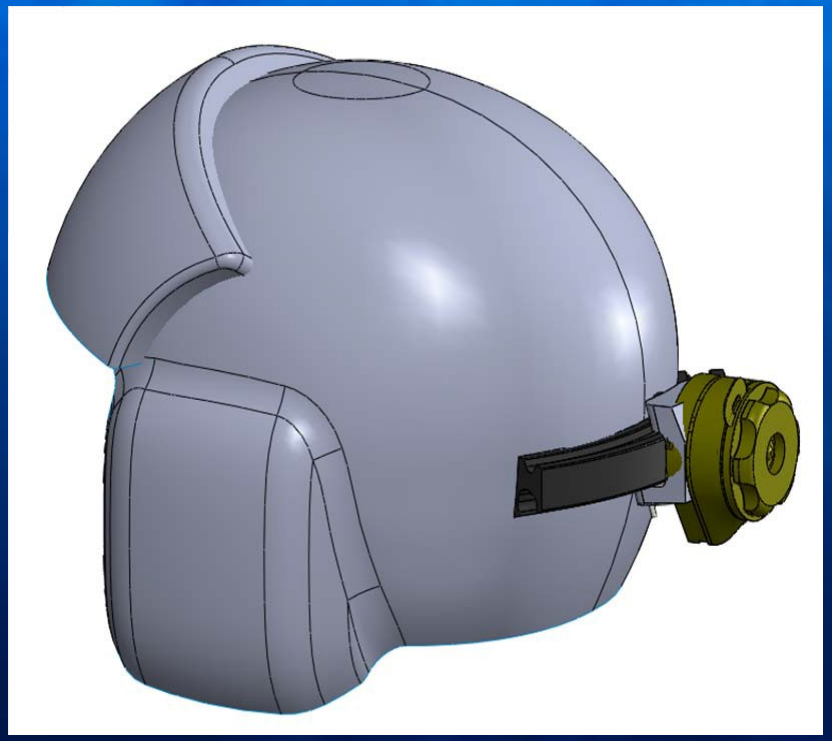
- Effects of seat on physiological response
  - OEM
  - 2 layer urethane
  - 1 layer monoprene
- One-size-fits-all vibration dampening cushion UNLIKELY
- Active seat/cushion solutions may be required where customization is not possible

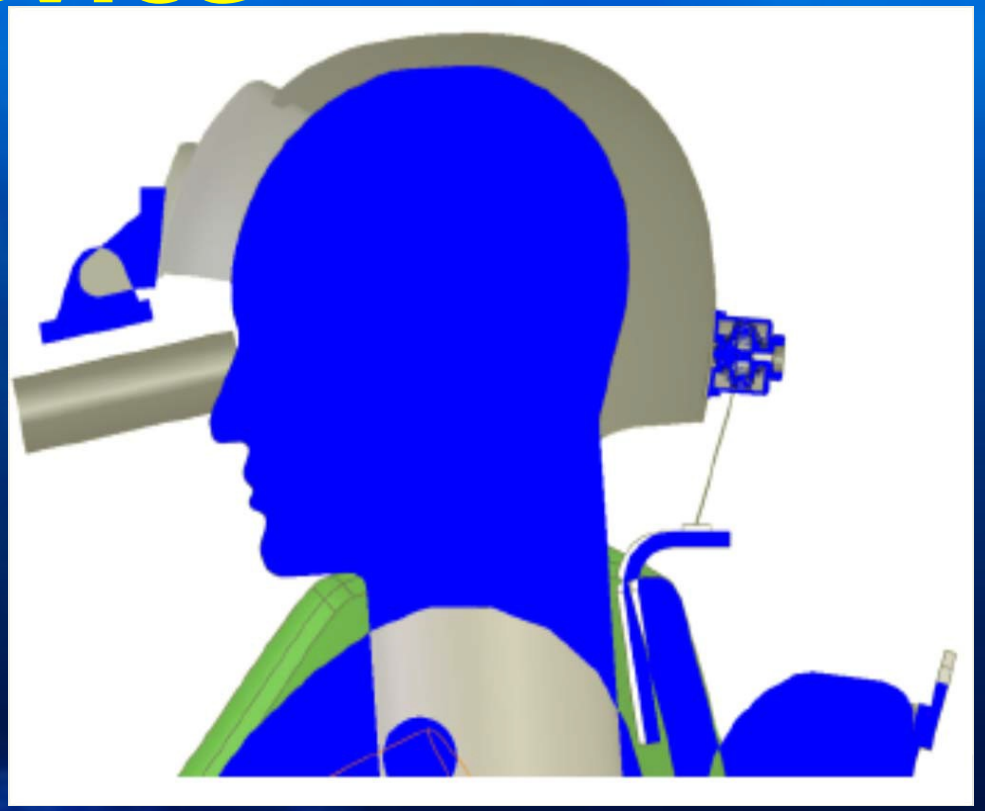


Head Supported Mass



Helmet System Support Device





Intervention Programs

- Exercise studies
  - RCAF Study
  - BEL/NLD Study
- ALSE
  - Helmet & Harness Fit
  - Helmet/LPSV mismatch
- Work-Rest Cycles
- Revised task and/or postural sequences
- Education

Questions?

Interested in collaborating?

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